PATENT

DOCKET NO.: 29284/548

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS	:	Mitsuo TAKUDA, et al.
SERIAL NO.	:	09/960,479
FILED	:	24 September 2001
FOR	:	METHOD AND APPARATUS FOR PROCESSING A MICRO SAMPLE
GROUP ART UNIT	:	2881
EXAMINER	:	James P. Hughes

COMMISSIONER FOR PATENTS
Washington, DC 20231

INFORMATION DISCLOSURE STATEMENT
UNDER 37 C.F.R. § 1.97 & § 1.98

S I R:

In conformance with Applicant's duty of disclosure under 37 C.F.R. § 1.56 and § 1.97(c)(1), the references listed on the attached form PTO-1449 are hereby brought to the Examiner's attention.

In accordance with the requirements of 37 C.F.R. § 1.98, copies of the references are submitted herewith.

Statement of Relevancy

The enclosed "Prior Art Statement" was submitted to counsel for Applicants by a third party, H. Albert Richardson, Esq. Submission of this material does not indicate that Applicants agree with the positions taken therein. Furthermore, Applicants also note that Ohnishi et al is of record and has been fully considered by the Examiner as has Tomimatsu (EP 0 927 880).

However, in the spirit of full disclosure, the comments of this third party are provided for consideration by the Examiner.

Statement Pursuant to 37 CFR §1.97(c)(1) & (e)(2)

The undersigned attorney hereby states that no item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear in the "references cited" on any patent to issue therefrom.

Respectfully submitted,

Date: 5 February 2003

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FORM PTO-1449
INFORMATION DISCLOSURE STATEMENT BY APPLICANT(S)

Atty Docket No.	: 29284/548
Serial No.	: 09/960,479
Inventors	: Mitsuo TOKUDA et al.
Filed	: 24 September 2001
Group Art Unit	: 2881
Examiner	: James P. Hughes

U.S. PATENT DOCUMENTS

Examiner Initial	Patent Number	Patent Date	Name	Class/ Subclass	Filing Date
JH	4,476,386	10/09/84	REID, et al.	250/310	

FOREIGN PATENT DOCUMENTS

Examiner Initial	Document Number	Date	Country	Class/ Subclass	Translation Yes	No

OTHER DOCUMENTS

(Including Author, Title, Date, Pertinent Pages, Etc.)

Examiner Initial

JH 1. Ohnishi, T., et al.: *A new focused-ion-beam microsampling technique for TEM observation of site-specific areas.* ISTFA '99. PROCEEDINGS OF THE 25TH Internaitonal Symposium for Testing and Failure Analysis. ASM Int. 1999, pp. 449-53 (14-18 Nov. 1999). Materials Parks, OH, USA

JH 2. Pawley, James B.,: *A Dual Needle Piezoelectric Micromanipulator for the Scanning Electron Microscope.* The Review of Scientific Instruments, Vol. 43, No. 4, April 1972.

EXAMINER: James P. Hughes — DATE CONSIDERED: 8/1/03

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

PRIOR ART STATEMENT

In re:

Applicants:	Tokuda, Mitsuo, et al.
Assignee:	Hitachi, Ltd.
Application no.	09/960,479
Title:	Method and Apparatus for Processing a Micro Sample
Filing date:	September 24, 2001
Group Art Unit:	Not known
Status:	Published May 2, 2002, number 2002/0050565

1. The prior art discussed below appears material to the patentability of the claims pending in the above-referenced patent application. The prior art documents are listed on Form PTO-1449, and a copy of each document cited is included with this statement. Reference letters refer to the identification of documents in Form PTO-1449.

Claim 1

2. Ohnishi, et al. (AB) disclose a focused ion beam optical system (Fig. 3, 5/9-17, ref. num. 101, etc.); an electron beam optical system (col. 1, line 31, ref. num. 74); a detector for detecting a secondary particle from a sample (col. 5, lines 30-32, ref. num. 109); a sample stage (col. 5,line 18-19, ref. num. 108); a probe for supporting a sample cut out by an ion beam (col. 5, line 44, ref. num. 31); and a mechanism for operating the probe so that the sample becomes perpendicular to the axis of the electron beam (Fig. 7, col. 5 lines 40-53, col. 6, lines 23-35).

2. Tomimatsu, et al. (AC) also disclose a focused ion beam optical system (Fig. 1, ¶¶ 0026, 0033, ref. num. 1); an electron beam optical system (Fig. 1, ¶¶ 0026, 0033, ref. num. 9); a detector for detecting a secondary particle from a sample (Fig. 1, ¶¶

0026, 0033, ref. num. 12); a sample stage (Fig. 1, ¶¶ 0026, 0033, ref. num. 3); and a probe for supporting a sample cut out by an ion beam (Fig. 1, ¶¶ 0026, 0033, ref. num. 11).

3. The Ohnishi, et al. paper (AF) discloses and describes rotation of a sample by means of a probe to make the sample perpendicular to an electron beam. (Ohnishi, et al. (AB) Figs. 1 and 3, p. 450).

Claim 2

4. Ohnishi, et al. (AB) disclose a focused ion beam optical system (Fig. 3, 5/9-17, ref. num. 101, etc.); an electron beam optical system (col. 1, line 31, ref. num. 74); a detector for detecting a secondary particle from a sample (col. 5, lines 30-32, ref. num. 109); a sample stage (col. 5,line 18, ref. num. 108); a probe for supporting a sample cut out by an ion beam (col. 5, line 44, ref. num. 31); and a moving mechanism for moving the probe (col. 5 lines 18-25; 40-53, col. 6, lines 23-35).

5. Tomimatsu, et al. (AC) discloses a focused ion beam optical system (Fig. 1, ¶¶ 0026, 0033, 43, ref. num. 1); an electron beam optical system (Fig. 1, ¶¶ 0026, 0033, ref. num. 9); a detector for detecting a secondary particle from a sample (Fig. 1, ¶¶ 0026, 0033, ref. num. 12); a sample stage (Fig. 1, ¶¶ 0026, 0033, ref. num. 3); a probe for supporting a sample cut out by an ion beam (Fig. 1, ¶¶ 0026, 0033, ref. num. 11); a moving mechanism for moving the probe (Fig. 1, ¶ 0037, ref. num. 4).

Claim 8

6. Ohnishi, et al. (AB) disclose a focused ion beam optical system (Fig. 3, 5/9-17, ref. num. 101, etc.); a lens for focusing an ion beam from the ion source (col. 5,

lines 10-11, ref. nums. 101, 106); a scanning deflector for scanning with the ion beam (col. 5, line 12, ref. num. 105); an electron beam optical system, a lens for focusing an electron beam, and a scanning deflector for scanning with the electron beam (col. 1, line 31, ref. num. 74, inherently requiring an electron beam optical system, which is well known in the art); a vacuum container (inherent in an electron-beam optical system); the step of cutting out a minute sample using a focused-ion beam (FIB) (col. 6, lines 8-27); lifting the cut-out minute sample from the sample using a probe (col. 6, lines 53-54, Figs. 1(e-f)); changing the attitude of the minute sample by operating the probe when the minute sample is being lifted (col. 8, lines 58-68, col. 9, lines 1-6; Fig. 7); and, applying the electron beam to a section of the minute sample after the attitude of the minute sample is changed (col. 8, lines 58-68, col. 9, lines 1-6; Fig. 7).

7. Tomimatsu, et al. (AC) disclose a focused ion beam optical system (Fig. 1, ¶¶ 0026,0033, 43, ref. num. 1); a lens for focusing an ion beam from the ion source (Figs. 1, 5, ¶¶ 0022, 0036, 0045, ref. num. 50); a scanning deflector for scanning with the ion beam (Figs. 1, 5, ¶ 0045); an electron beam optical system (Fig. 1, ¶¶ 0026, 0033, ref. num. 9); a lens for focusing an electron beam (Figs. 1, 5, ¶ 0039, ref. nums. 15, 49, 50); a scanning deflector for scanning with the electron beam (Figs. 1, 5, ¶ 0039, ref. num. 15); a vacuum container (Fig. 1, ref. num. 77); the step of cutting out a minute sample using a focused-ion beam (FIB) (Figs. 17, 27, ¶¶ 0124, 0125); and lifting the cut-out minute sample from the sample using a probe (Fig. 27, ¶¶ 0126, 0127).

8. The Ohnishi, et al. paper (AF) discloses changing the attitude of the minute sample by operating the probe when the minute sample is being lifted, rotation of the sample with the probe to make the sample perpendicular to an electron beam, and applying an electron beam to the minute sample. (Ohnishi, et al. Figs. 1 and 3, p. 450).

Claim 12

9. Ohnishi, et al. (AB) inherently disclose a vacuum container, required to be used with charged-particle beams; a sample stage (col. 5, line 18, ref. num. 108); a charged particle source (Fig. 3, the ion or electron beam, col. 5, lines 5-17); an application optical system for applying a charged particle beam to the sample (Fig. 3, col. 5, lines 30-32); a secondary particle detector (col. 5, line 32, ref. num. 109); a needle member having a tip for contact with a sample (i.e., a probe) (col. 5, line 44, ref. num. 31); a probe holder for holding the needle (the manipulator) (col. 5, lines 40-53, ref. num.112).

10. Tomimatsu, et al. (AC) disclose a vacuum container, (Fig. 1, ref. num. 77); a sample stage (Fig. 1, ¶¶ 0026, 0033, ref. num. 3); a charged particle source (Fig. 1, the ion or electron beam); an application optical system for applying a charged particle beam to the sample (Figs. 1, 5A, and 5C); a secondary particle detector (Fig. 1, ¶¶ 0026, 0033, ref. num. 12); a needle member having a tip for contact with a sample (i.e., a probe) (Fig. 20, ¶ 0090, ref. num. 11); and a probe holder for holding the needle (Figs. 6C and 20A, ¶¶ 0053, 0092, ref. nums. 30, 71).

11. Pawley (AG) discloses a mechanism capable of introducing and extracting a probe holder from a vacuum container. Pawley discloses a micromanipulator inserted into the specimen chamber of a scanning-electron microscope and retracted into an airlock. (Pawley, Fig. 1, p. 601).

Claim 13

12. Ohnishi, et al. (AB) disclose a vacuum container, inherent in a charged-particle beam system; a first charged particle source (Fig. 3, ion or electron beam, col. 5, lines 5-17); an application optical system for separating part of a sample with a charged-particle beam from the first charged particle source (Fig. 3, col. 6, lines 8-27); a needle member for extracting the separated sample piece (col. 6, lines 53-54, ref. num. 31); a probe holder for holding the needle (col. 5, lines 40-53, ref. num. 112); a second charged-particle source and a second application optical system (Fig. 3, ion or electron beam); a secondary particle detecting means (col. 5, lines 30-32 ref. num. 109); and a moving mechanism for moving the probe (col. 5, lines 40-53; col. 6, lines 23-25, ref. num. 112).

13. Tomimatsu, et al. (AC) disclose a vacuum container (Fig. 1, ref. num. 77); a first charged particle source (Fig. 1, ion or electron beam); an application optical system for separating part of a sample with a charged-particle beam from the first charged particle source (Figs, 1, 17, 27, ¶¶ 0124, 0125); a needle member for extracting the separated sample piece (Fig. 20, ¶ 0090, ref. num. 11); a probe holder for holding the needle (Figs. 6C and 20A, ¶¶ 0053, 0092, ref. nums. 30, 71); a second charged-particle source and a second application optical system (Figs. 1, 17, 27, ¶¶ 0124, 0125); a

secondary particle detecting means (Fig. 1, ¶¶ 0026, 0033, ref. num. 12); and a moving mechanism for moving the probe (Fig. 1, ¶ 0037, ref. num. 4).

14. Pawley (AG) discloses a mechanism capable of introducing and extracting a probe holder from a vacuum container. Pawley discloses a micromanipulator inserted into the specimen chamber of a scanning-electron microscope and retracted into an airlock. (Pawley, Fig. 1, p. 601).

Claim 15

15. Ohnishi, et al. (AB) disclose a vacuum chamber, inherent to a charged-particle system; a sample stage (col. 5, line 18, ref. num. 108); a first charged-particle source (Fig. 3, ion or electron beam); a first application optical system for separating part of a sample on the sample stage with a charged particle from the first charged-particle source (Fig. 3, col. 6, lines 8-27); a needle member for extracting the separated sample piece (col. 5, line 44, ref. num. 31); a first probe holder for holding the needle (col. 5, lines 40-53 (112); a second probe holder for taking the extracted sample out of the vacuum container (col. 5, lines 40-53 (112); a second charged-particle source (Fig. 3); a second application optical system (Fig. 3); a secondary particle detector (col. 5, line 30-32, ref. num. 109); and a moving mechanism having a structure of moving the first and second probe holders in the vacuum chamber and inclining the first and second probe holders to a surface of the sample (col. 5, lines 40-53, ref. num. 112).

16. Tomimatsu, et al. (AC) disclose a vacuum chamber, (Fig. 1, ref. num. 77); a sample stage (Fig. 1, ¶ 0026, 0033, ref. num. 3); a first charged-particle source (Fig. 1,

ion or electron beam); a first application optical system for separating part of a sample on the sample stage with a charged particle from the first charged-particle source (Figs. 1, 17, 27, ¶¶ 0124, 0125); a needle member for extracting the separated sample piece (Fig. 20, ¶ 0090, ref. num. 11); a first probe holder for holding the needle (Figs. 6C and 20A, ¶¶ 0053, 0092, ref. nums. 30, 71); a second probe holder for taking the extracted sample out of the vacuum container ((Figs. 6C and 20A, ¶¶ 0053, 0092, ref. nums. 30, 71); a second charged-particle source (Fig. 1, ion or electron beam); a second application optical system (Fig. 1, ion or electron beam); and a secondary particle detector (Fig. 1, ¶¶ 0026, 0033, ref. num. 12).

17. Pawley (AG) discloses a mechanism capable of introducing and extracting a probe holder from a vacuum container. Pawley discloses a micromanipulator inserted into the specimen chamber of a scanning-electron microscope and retracted into an airlock. (Pawley, Fig. 1, p. 601).

Claim 16

18. Ohnishi, et al. (AB) disclose a vacuum chamber, inherent to a charged-particle system; a sample stage (col. 5, line 18, ref. num. 108); a charged-particle source (Fig. 3); an application optical system for applying a charged particle from the charged-particle source to the sample (Fig. 3); a secondary particle detector (col. 5, line 32, ref. num. 109); and a needle member whose tip can be brought into contact with the sample (col. 6, lines 53-54, ref. num. 31).

19. Tomimatsu, et al. (AC) disclose a vacuum chamber, (Fig. 1, ref. num. 77); a sample stage (Fig. 1, ¶¶ 0005, 0033, ref. num. 11, 36); a charged-particle source (Fig. 1, ion or electron beam); an application optical system for applying a charged particle from the charged-particle source to the sample (Fig. 1, an ion or electron beam); a secondary particle detector (Fig. 1, ¶¶ 0026, 0033, ref. num. 12); and a needle member whose tip can be brought into contact with the sample (Fig. 20, ¶ 0090, ref. num. 11).

Dependent claims

20. Dependent claims 3, 4, 5 and 7 claim a "moving mechanism" for controlling the angle of the specimen with respect to the ion beam. Ohnishi, et al. (AB) disclose such a moving mechanism (col. 5 lines 18-25; 40-53, col. 6, lines 23-35).

21. Dependent claim 6 claims a detector for detecting X-rays generated from a sample. The use of such detectors for analyzing material inside a charged-particle instrument is well known; e.g. as disclosed in Reid, et al. (AA), col. 1 generally.

22. Dependent claim 9 claims the step of controlling the probe so that the section of the minute sample becomes substantially perpendicular to an optical axis of the electron beam. The Ohnishi, et al. paper (AF) discloses and describes rotation of a sample by means of a probe to make the sample perpendicular to an electron beam. (Ohnishi, et al. Figs. 1 and 3, p. 450).

26. Dependant claim 10 claims a processing method where the resulting shape of the minute sample is tetrahedron or pentahedron. Such sample shapes are disclosed by Ohnishi, et al. (AB), Fig. 1(g); and in Tomimatsu, et al. (AC), Figs. 17, 18, 27.

27. Dependent 11 claims a processing method where the sample is a semiconductor wafer with or without patterns. Paragraphs 2 and 10 of the subject

application describe this "pattern" as a circuit pattern. Tomimatsu, et al. (AC) describe the fabrication of a specimen from "a specimen substrate such as a semiconductor wafer or a semiconductor device chip," thus distinguishing between semiconductor material with or without circuit patterns. Tomimatsu, et al., ¶ 0001.

28. Dependent claim 14 claims a sample processing apparatus where a first charged-particle source and optical system and a second charged-particle source and optical system are "relatively disposed in a slanting manner to a sample-placing surface of [a] sample stage." Such a two-beam system is well-known in the art, being disclosed in Tomimatsu, et al. (AC), Fig. 1 and ¶ 0034 (ion beam optical system 1 and electron beam optical system 9); and ¶ 0035 discussing a sample stage capable of moving so the angle of the ion beam (and, necessarily, the electron beam) may be set at "a glancing angle and a rotation angle" with respect to the specimen substrate.

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